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**VIA ELECTRONIC FILING**

Marlene H. Dortch, Secretary  
Federal Communications Commission  
445 Twelfth Street, S.W.  
Washington, DC 20554

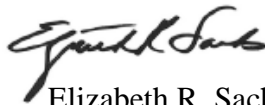
**Re: WT Docket No. 17-200  
Notice of *Ex Parte* Presentation**

Dear Ms. Dortch:

pdvWireless, Inc. is submitting the attached “A Cost-Benefit Analysis of Proposals to Restructure the 900 MHz Band” prepared by Utilicom Advisors LLC.

This presentation is being filed electronically, in accordance with Section 1.1206(b) of the Commission’s Rules, 47 C.F.R. § 1.1206(b), for inclusion in the record in this proceeding.

Sincerely,



Elizabeth R. Sachs  
Counsel, pdvWireless, Inc.

Attachment



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Companies

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## A Cost-Benefit Analysis of Proposals to Restructure the 900 MHz Band

Harold Furchtgott-Roth  
Utilicom Advisors LLC\*

WT Docket No. 17-200

October 2017

\* We gratefully acknowledge a grant from pdvWireless for the preparation of this cost-benefit analysis. The views in this report, and any errors contained herein, are entirely those of Utilicom Advisors, LLC.

## **Executive Summary**

This paper examines the social costs and benefits of the spectrum proposal of Enterprise Wireless Alliance and pdvWireless. We have calculated the increased market value and the increased consumer surplus generated from putting additional 900 MHz spectrum into more efficient use. We calculate the market value of this increased use to be at least \$1 billion, and the net present value of increased consumer surplus to be at least \$10 billion. Consideration of the other social benefits of the plan would increase the value substantially. Every year of delaying implementation of the EWA/pdvWireless plan costs American consumers at least \$1 billion. In sum, the increased value to society of moving forward with the EWA/ pdvWireless proposal significantly outweighs any potential costs. No social costs or new negative externalities associated with the EWA/ pdvWireless proposal have been identified in the record, while the benefits are significant.

## **Background**

Earlier this year at the Hudson Institute, Chairman Ajit Pai called for more economic analysis in FCC rulemakings.<sup>1</sup> The absence of economic analysis in the proceedings of independent agencies is widely known.<sup>2</sup> Although the FCC provides regulatory flexibility analyses for rulemakings, these “analyses” are usually boilerplate documents, varying little from rulemaking to rulemaking, and providing little insight or documentation of possible benefits or costs of the

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<sup>1</sup> Hudson Institute, Commission Chairman Ajit Pai on Economic Analysis at the FCC, April 5, 2015, at <https://www.hudson.org/events/1415-commission-chairman-ajit-pai-on-economic-analysis-at-the-fcc42017>.

<sup>2</sup> See, e.g., testimony of H. Furchtgott-Roth, **Testimony before the U.S. House of Representatives, Judiciary Committee, Subcommittee on Courts, Commercial and Administrative Law, “Cost-Justifying Regulations: Protecting Jobs and the Economy by Presidential and Judicial Review of Cost and Benefits,” May 4, 2011.**

rules. If an individual or court sought a list of the possible benefits and costs of a rule or a proposed rule, or risks and timelines associated with a rule or proposed rule, the Commission has rarely if ever had a document to summarize or to list those benefits, costs, risks, and timelines.

The Commission has received petitions for the potential restructuring of the 900 MHz band. The Commission has issued a Notice of Inquiry (“NOI”) to examine these petitions as well as broader thematic issues related to spectrum management and the 900 MHz band.<sup>3</sup> In the NOI, the Commission reviews the current structure of the 896-901/935-940 MHz band (“900 MHz band”).<sup>4</sup> Governing rules are in Part 90, Subpart S.

The 900 MHz band is primarily allocated for private networks for various business and industrial activities, and for commercial mobile radio services, but not for broadband networks, which are the subject of much Commission deliberation. Practically all of the comments in this proceeding are from parties with interests in the private business and industrial networks.

Utilities and other industries rely on networks in the 900 MHz spectrum band. While observing that regulatory history of the band dates back to 1970 and before,<sup>5</sup> the Commission wryly notes that the band has “undergone few changes since 1986.”<sup>6</sup> The band is divided into 12.5 kHz channels, and licenses can be used for Business/Industrial/Land Transportation (B/ILT) purposes and Specialized Mobile Radio (SMR) purposes. In 1986, the band was equally divided between SMR and B/ILT applications.<sup>7</sup> The B/ILT and SMR licenses are primarily for a mobile service.

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<sup>3</sup> FCC, Notice of Inquiry, Review of the Commission’s Rules Governing the 896-901/935-940 MHz Band, August 4, 2017, “NOI”.

<sup>4</sup> NOI, paragraphs 1-11.

<sup>5</sup> Ibid., paragraph 3.

<sup>6</sup> Ibid., paragraph 1.

<sup>7</sup> Ibid., paragraph 3.

Commission rules list the frequencies of each of the 399 12.5 kHz channels in the band.<sup>8</sup> The Commission provides a map of 2,700 900 MHz B/ILT sites that have not converted to SMR.<sup>9</sup> Large swaths of the country apparently have few if any licensees, and a significant amount of the 900 MHz band in secondary and tertiary markets is unused because it is retained by the Commission.

While less visible to the public, these private business and industrial networks in the 900 MHz band provide three key elements:

- a. *Spectrum for day-to-day operations of critical infrastructure* -- Their importance for critical infrastructure is underscored by the frequent notices that these networks are potential terrorist targets.<sup>10</sup> Disable these aging networks and America itself is disabled. While many of these private networks were state-of-the-art when they were deployed decades ago, few are today. Many businesses are in the process of renovating these networks, impeded by the limitations of 12.5 kHz channels.
- b. *Spectrum to innovate for homeland security* -- These private communications networks need to be upgraded with new innovative technologies to make our critical infrastructure resilient to attacks. Although these networks could, in theory, be built in other spectrum bands, the 900 MHz band is already allocated for such networks. Such networks could be enhanced with broadband capabilities including better security from physical and cyber attacks.

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<sup>8</sup> 47 CFR 90.613.

<sup>9</sup> NOI, paragraph 7.

<sup>10</sup> Citations.

c. *Spectrum for weather events and natural disasters* -- The band not merely provides critical infrastructure to American industry during day-to-day operations, it also provides capacity for networks during weather events and natural disasters. The private 900 MHz networks are often built to a higher standard than public networks. The vast range of the 900 MHz band can also be used for broadband applications. Recently, when Puerto Rico was devastated by a hurricane, Google was able to establish a temporary aerial broadband network based on 900 MHz spectrum from pdvWireless and others using existing LTE band 8 handsets. Thus the 900 MHz band is a safety valve that helps ensure the survivability of communications systems during times of natural disasters.

While past proceedings in this band have not benefited from cost-benefit analyses, in the current proceeding, the Commission has taken a different approach. In more than one dozen instances, the NOI seeks comments on the various costs and benefits of proposals for the 900 MHz band.<sup>11</sup> This report responds to the Commission's requests for those costs and benefits with respect to the Enterprise Wireless Alliance and pdvWireless ("EWA/pdvWireless") petition and subsequent modifications.<sup>12</sup> Because the Commission has little formal experience with cost-benefit analyses

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<sup>11</sup> NOI.

<sup>12</sup> Petition for Rulemaking of the Enterprise Wireless Alliance and Pacific DataVision, Inc., RM-11738 (filed Nov. 17, 2014), <http://appsint.fcc.gov/ecfs/document/view?id=60001008215>. EWA/pdvWireless subsequently filed a Supplement containing draft proposed rules. Ex Parte Comments, Proposed 900 MHz PEBB Allocation Rules (filed May 3, 2015), <http://appsint.fcc.gov/ecfs/document/view?id=60001011470> (EWA/pdvWireless Supplement). The Bureau sought comment on the EWA/pdvWireless Petition and on the Supplement. See Wireless Telecommunications Bureau Seeks Comment on Enterprise Wireless Alliance and Pacific DataVision, Inc. Petition for Rulemaking Regarding Realignment of 900 MHz Spectrum, Public Notice, 29 FCC Rcd 14424 (WTB MD 2014); Wireless Telecommunications Bureau Seeks Comment on Supplement to Enterprise Wireless Alliance and Pacific DataVision, Inc. Petition for Rulemaking Regarding Realignment of 900 MHz Spectrum, Public Notice, 30 FCC

in the context of rulemaking proceedings, much less NOIs, we offer some thoughts on the structure of such analyses below.

**I. The purposes of cost-benefit analyses for government agencies as distinct from private parties**

As a preliminary matter, let us note that the purpose of a cost-benefit analysis for a proposed project by a government agency such as the Commission is different from a cost-benefit analysis for a project by a private party. For the private party, all that needs to be considered are factors directly related to the private party: the costs and benefits directly to that party, the various risks and preferences associated with those costs and benefits, and various time preferences. Private benefits and costs are not necessarily fully known, but we make decisions daily and are only answerable to ourselves. We may not fully know the private costs and benefits of each of the options we face, but we make decisions based on the information we have. And we have every incentive to collect as much or as little information as we need to make a private decision. We make decisions many times a day from the important to the mundane. Thus, we decide to rent an apartment on a month-to-month basis rather than a full-year lease. We choose one bag of potatoes rather than another at the supermarket.

Every individual may conduct private cost-benefit analyses in a different personal manner, and we all make these judgments, and we usually benefit from our own personal judgments. Each of us makes these decisions, and we choose options where we perceive benefits to exceed costs, based on our personal judgments and weights. We rarely if ever document our personal decisions. We are answerable only to ourselves for private decisions, and usually we approve of

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Rcd 4763 (WTB MD 2015).

the decisions we have made. Businesses make similar decisions for business interests. Others, including the government, have little reason to second-guess these private judgments.

Government decisions are different. Three factors that private parties would not consider stand out: the rule of law and property rights, externalities, and economic welfare of society.

*A. Rule of law and property rights*

Both private parties and governments have strong interests in preserving the rule of law and property rights.<sup>13</sup> The first consideration of property rights by a government agency is to ensure that its rules are consistent with statutes. Rules should adhere to statutes, and rules are often necessary for spectrum to identify boundaries of use, to set power limits, and to ensure protection from interference.

Government decisions that are arbitrary or that erode property rights, particularly if unnecessary by statute, are contrary to the interests of both the government responsible for enforcing laws and of private entities that benefit from the rule of law and private property. As part of a cost-benefit analysis, a government agency could ask simple questions such as:

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<sup>13</sup> By property rights, we mean a coherent, predictable, and reliable set of rules of by which (1) assets, including spectrum rights, can be used at the discretion of asset owners; (2) benefits can be derived by asset owners from those uses; and (3) asset owners can benefit from transactions. For applications of property rights to spectrum, see H. Furchtgott-Roth, “The Economic Value of Property Rights Concepts in Spectrum, Both With and Without Licenses,” Hudson Institute, April 4, 2014, at <https://www.hudson.org/research/13502-the-economic-value-of-property-rights-concepts-in-spectrum-both-with-and-without-licenses>.



1. *Is a rule necessary by statute?* – The current rules for 900 MHz band have been developed over the past 30 years or more.<sup>14</sup> We have seen no evidence that the rules are inconsistent with statute, but we have also seen no evidence that the underlying statute requires the specific narrowband treatment of 12.5 kHz channels. In the 1980s, these were rules for state-of-the art technology. Neither the rules, nor the technology they support, remain state of the art. Nor does the statute require the Commission to retain licenses in much of the country.
2. *Does the rule limit or expand the use of an asset?* In the case of 900 MHz licenses, the current rules unnecessarily limit the technologies that can be deployed by limiting licenses to 12.5 kHz channels and limited geographies. The current 900 MHz BILT licensees, including utilities, have many important uses of the spectrum.<sup>15</sup> Much of the narrowband applications are for voice. Although the rules for the 900 MHz band do not specify limitations on technology, the 12.5 kHz licenses implicitly limit the types of equipment that can be used. Broadband did not exist at the time the 900 MHz rules were established. Special rules apply for the transfer of licenses in the 900 MHz band.<sup>16</sup> The prospects of aggregating 900 MHz licenses for new purposes would be difficult if not impossible under current rules.

There is very little technological optionality of use for current licensees. Within either B/ILT or SMR, the narrow channel sizes materially limit potential equipment and potential applications. While it is not difficult to reassign a B/ILT license as SMR and vice versa, it is impossible to adopt a wide range of current technologies in a 12.5 kHz channel.

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<sup>14</sup> 47 CFR, Part 90 Rules, Subpart S.

<sup>15</sup> NOI, paragraphs 9-11.

<sup>16</sup> See 47 CFR 90.609.

3. *Does the rule limit or expand the benefits an owner or user derives from the asset?*

Current rules allow licensees to benefit from licenses. Current licensees have the rights to benefit from the current use—as well as options for future use--of the spectrum and to benefit from transactions involving the spectrum. But current uses are limited, and transactions in the band are few. All of the property rights associated with current licensees would apply equally to potential future licensees.

Two other groups are worth considering in terms of benefits from the use of 900 MHz.

Consumers benefit from the use of applications of 900 MHz, either directly as SMR consumers or indirectly as consumers of products and services from industrial 900 MHz licensees. But the current consumer benefits are limited as the technologies are limited. Consumers would benefit even more under alternative rule structures that would allow a wider range of useful technologies.

The federal government has little if any benefit from the current 900 MHz license structure. The government receives little if any direct benefit from current or potential use choices by licensees, much less by their actual use. The government receives no benefit from the many unassigned 900 MHz licenses in the FCC's portfolio. The government receives no benefit from the few if any license transactions in the band.

4. *Does the rule limit or expand the benefit from transactions of the asset?* Current rules allow licensees to benefit from transactions, although such transactions are rare.

These are simple questions, often easily answered, but rarely asked by government agencies in considering whether to adopt new rules.

A government agency should have a presumption that reliance on property rights and markets are superior to government rules unless substantial public costs or unavoidable statutory requirements.

### *B. Externalities*

If a proposed project affects others, either positively or negatively, other than risks associated with those consequences, they are not a particular concern to a private party. For a government agency, a cost-benefit analysis is a different matter. The government agency should focus heavily on the broader costs and benefits, sometimes called social costs and benefits, sometimes called externalities,<sup>17</sup> not accounted for by private parties in a series of transactions. A governmental rule change that would strengthen property rights and allow a wireless company to provide services to the public or new services to private enterprise or critical infrastructure would have benefits far beyond the private benefits from the profits associated with providing those services. A government rule change that would put currently unused spectrum to more robust use while holding incumbent users of the band harmless would be another example of a rule change that could have a positive externality. In both examples, consumers using the services offered by providers would also benefit from the rule changes.

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<sup>17</sup> By externality, we mean a decision made by one party that affects another party, either positively or negatively.

But the consumers using those services benefit as well through consumer surplus—how much more they would have been willing to pay for the services relative to what they actually paid. And consumers who are part of the broader communications network around the globe, not just those purchasing directly from the wireless company, benefit from having more users on the network. Economies of scale and scope offer lower costs, and functional innovation when global aggregate demand is harnessed. Similarly, the vendors to the wireless company also benefited from the profits they derived from providing services. And the broader economy, even those who do not directly consume the wireless services, benefit from the increased level of economic activity. These are but a few examples of the broader social benefits associated with a wireless company offering wireless services on newly unleashed broadband spectrum. Reflexively, these are part of the broader social costs of a wireless company not being allowed to offer wireless services.

Other forms of externalities unleashed specifically in the context of new rules in the 900 MHz band from improved private networks could include the greater survivability of a network against homeland security and national security threats or in times of natural disasters. The network owner would obtain private benefits from greater survivability, but customers and entire populations that might be able to use the private network in times of emergency would also benefit.

Of course, rule changes may also have substantial social costs. Thus, a rule change might weaken or limit property rights, reducing not merely private economic activity in the regulated market but reducing economic activity in other markets by businesses and individuals concerned that a similar harmful rule might be applied in their market. A rule change might increase the

risks of doing business. Private cost-benefit analyses will not fully capture these and other social costs. In this band, there are no identifiable, let alone “substantial,” social costs.

### *C. Economic welfare*

Government decisions may also differentially affect individuals depending on market conditions. Paul Samuelson developed a method to calculate the value of public goods such as parks or national defense by adding together the consumer surplus values of all of those affected by the public good.<sup>18</sup> Similar examples are available in the wireless sector. Thus, for example, suppose that the federal government had a spectrum fee per MHz pop of spectrum used. Suppose the spectrum fee raised \$x dollars annually but reduced use of spectrum by y% for each consumer. Suppose that demand for spectrum were very elastic, that is price-sensitive. The annual loss of consumer surplus might be \$y\*pop, a value much greater than the \$x raised by the spectrum fee. With a 10% discount rate, the comparison of the net present value of spectrum fees would be \$10x, and the net present value of lost consumer welfare would be \$10y\*pop. Removing the spectrum fee might not necessarily improve property rights or address externalities, but it would increase economic welfare by increasing consumer surplus substantially at a relatively small cost in lost revenue.

Another form of economic welfare is overall efficiency in the market. Thus, if a rule change made a band of spectrum substantially more efficient, that could be treated as an improvement in economic welfare.

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<sup>18</sup> See P.A. Samuelson. (1954), “The Theory of Public Expenditure.” *Review of Economics and Statistics*, 36, pp. 386–389; P.A. Samuelson, (1955), “Diagrammatic Exposition of a Theory of Public Expenditure,” *Review of Economics and Statistics*, 37, pp. 350–56.

*D. Equity considerations and private transactions*

There are some considerations that should not be part of a governmental cost-benefit analysis of new rules. These considerations include equity considerations among different individual parties. Thus, suppose if under current rules, Party A pays Party B \$1 per year, and under a proposed rule, Party B would instead pay Party A \$1 per year. Assuming other factors are the same, the government should be indifferent as to whether Party A or Party B benefits from a rule. Or, if under a proposed rule, Party B would be compelled to pay Party A an amount to be determined later. As long as the payment will ultimately be made, the government should be indifferent in adopting the rule to claims by Party A that the amount to be paid should be \$1 or \$10.

**II. Alternative case, EWA/pdvWireless proposal**

*A. The EWA/pdvWireless Proposal*

The EWA/pdvWireless proposal has several components which we summarize as follows:

1. Allow greater aggregation of 900 MHz licenses;
2. realign the 900 MHz band into a 3/3 megahertz broadband segment (898-901/937-940 MHz) called the Private Enterprise Broadband (PEBB) license and a 2/2 megahertz narrowband segment (896-898/935-937 MHz);
3. a single licensee in each MTA be assigned the PEBB license for the broadband segment;
4. the narrowband segment would continue to be used for site-based B/ILT and MTA SMR narrowband operations
5. Current B/ILT and SMR licensees below 898/937 MHz retaining their current assignments;

6. Current B/ILT and SMR licensees above 898/937 MHz retaining current license structure but being reassigned a license below 898/937, with expenses incurred by the new PEBB licensee in the MTA;<sup>19</sup>
7. After relocation and band realignment, the PEBB licensee would be required to “offer a build-to-suit broadband solution” to any requesting B/ILT entity, with mandatory priority access for critical infrastructure industry (CII) entities;<sup>20</sup> and
8. Power limits, out-of-band emissions and other protections would remain the same for narrowband systems, but the PEBB licensee would be subject to more stringent technical rules to prevent potential interference.

Altogether, these eight factors would hold all incumbent licensees harmless.

#### *B. Costs of the EWA/pdvWireless Proposal*

No social costs or new negative externalities associated with the EWA/pdvWireless proposal have been identified in the record. Some parties in this proceeding claim that there are costs associated with the EWA/pdvWireless proposal, but these costs appear to be based on either a misreading of the proposal, or simply a statement of expenses they expect to be paid by a PEBB licensee. The PEBB license will incur costs of retuning transceivers. These complaints against the EWA/pdvWireless proposal appear to be the equity issues discussed above, outside of the

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<sup>19</sup> See EWA/pdvWireless Petition at 16. The relocation to comparable facilities would mean that a relocating licensee would experience no reduction in system capacity, coverage, or signal strength within the licensee’s coverage area. See *id.* SMR licensees could choose instead to negotiate with the PEBB licensee concerning the contribution of their spectrum rights to the PEBB license.

<sup>20</sup> See EWA/pdvWireless Petition at iii; see also EWA/pdvWireless Supplement at 12 (“the PEBB licensee shall engage in good faith negotiations with such PE/CII entity for a contract that will provide for the construction and operation of PEBB broadband system in the Private Enterprise Broadband allocation within the coverage area requested by the PE/CII entity”).

realm of direct government consideration. If the PEBB licensee makes other parties whole, they are no worse off. If the PEBB licensee refuses to comply with the requirements of the proposed rule, it presumably would not be the PEBB licensee. The comments about compensable private costs affect the value of a PEBB license, not the overall value of the EWA/pdvWireless proposal.

### *C. Benefits of the EWA/pdvWireless Proposal*

There are many benefits of the EWA/pdvWireless plan that we divide into three areas: rule of law and property rights; increased value of spectrum; and externalities.

#### 1. Preserve the rule of law and clearer property rights

The EWA/pdvWireless proposal would preserve the rule of law and would clarify the property rights of 900 MHz licenses, both those that choose to remain under the currently licensing regime and those that choose to become PEBB licensees. With the EWA/pdvWireless proposal, the PEBB licensee in each MTA would have a 3x3 MHz channel over an entire MTA. This is a much larger license than current 900 MHz licenses, both in terms of geography and bandwidth. It would be large enough to adopt a wide array of technologies, including LTE, that are currently foreclosed from the 12.5 kHz channels in the 900 MHz band. The greater flexibility in the choice of technologies would allow PEBB licensees to innovate with an array of technologies not currently possible in the 900 MHz band. Moreover, we can observe the enhanced property rights with the EWA/pdvWireless proposal:

##### *a) Determination of use*

One of the principal elements of property rights is the determination of use of an asset. Current licensees of the 900 MHz band would have no fewer rights to determine the use of licensed spectrum as they currently have. Under the EWA/pdvWireless proposal, the PEBB license goes



to the major MTA licensee or, if none, MTA licensees will negotiate among themselves. They would continue to have the same protections from interference as they currently have. Licensees would have greater optionality of use if they exercise the option to have “build-to-suit” broadband system from the PEBB licensee.

The EWA/pdvWireless proposal is consistent with other FCC objectives including: “flexibility, efficiency, and access in the use of other spectrum bands.”<sup>21</sup> These are the same benefits for the determination of use identified by the Commission in the first paragraph of the NOI.<sup>22</sup> Under the pdvWireless proposal, the PEBB licensee, as well other licensees seeking the “build-to-suit” option, would have greater flexibility of use to use technologies not constrained by 12.5 kHz channels. This in turn would lead to greater efficiency in the use spectrum in the 900 MHz band, which today is underutilized. The EWA/pdvWireless proposal would also increase spectrum accessibility, particularly in the many areas where the FCC holds unassigned licenses, by placing those licenses in use.

b) *Benefit from use*

Being able to benefit from the use of an asset is a key element of property rights. Current licensees in the 900 MHz band would continue to have rights to benefit from current use. They would continue to have the same protections from interference as they currently have. Licensees

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<sup>21</sup> See, e.g., Review of the Commission’s Part 95 Personal Radio Services Rules; Petition for Rulemaking of Garmin International, Inc.; Petition for Rulemaking of Omnitronics. L.L.C., Report and Order, FCC 17-57 (May 19, 2017); Amendment of Parts 1 and 22 of the Commission’s Rules with Regard to the Cellular Service, Including Changes in Licensing of Unserved Area, et al., Second Report and Order, Report and Order, and Second Further Notice of Proposed Rulemaking, 32 FCC Rcd 2518 (2017).

<sup>22</sup> NOI, paragraph 1.

would have greater benefit from optionality of use either as the PEBB license or through exercise of the option to have “build-to-suit” broadband system from the PEBB licensee.

*c) Benefit from transactions*

Transactions in the 900 MHz band today are rare. The EWA/pdvWireless proposal would likely increase the value of licenses, which in turn would likely spur more transactions. Licensees would continue to benefit from these transactions.

*d) Greater enforcement of property rights and the rule of law*

As will be described below, the EWA/pdvWireless proposal would lead to more valuable spectrum and more valuable uses of spectrum. These in turn would lead to greater incentives of licensees to protect those property rights under the rule of law.

2. Increased value of spectrum

The overall value of licenses in the 900 MHz band, both the PEBB and the narrowband licenses, would almost certainly increase with the EWA/pdvWireless proposal. Below, we review reasons for increased value of spectrum and provide a calculation of the increased value based narrowly on putting underused spectrum to greater use.

*Reasons for greater value*

- a. Greater flexibility of current use for PEBB licenses – the greater flexibility of use with 3x3 MHz broadband channels, such as LTE technologies, should

substantially increase the value of spectrum that would form PEBB licenses.<sup>23</sup>

These current technologies may be applied for industrial applications and to improve security for critical infrastructure and to deter cyber-security threats.

We find the potential critical infrastructure and cyber-security infrastructure applications in the 900 MHz band of particular unique value to American industry. Today, the most advanced communications networks are usually part of public networks offered by wireless common carriers. These networks are quite capable, but they are built to the specifications of the wireless carriers, not the unique specifications of individual businesses that use 900 MHz networks.

Utilities, for example, may require better backup and greater survivability during emergencies than common carrier networks. As examples, during recent hurricanes, utility narrowband networks were more likely to remain operational than wireless carrier broadband networks.<sup>24</sup> These private networks would be even more valuable with broadband capabilities.

Survivability during terrorist attacks is also important. Utilities are often referred to as terrorist targets,<sup>25</sup> and the survivability of utility networks is important.

PEBB licensees could help improve the survivability of critical infrastructure from terrorist attacks.

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<sup>23</sup> The new PEBB licenses would have substantial value, but a value offset in the near term by the costs of paying for: (1) the retuning and transition of incumbent 900 MHz licensees; and (2) requests for broadband services from incumbent licensees.

<sup>24</sup> [citations]

<sup>25</sup> citations.

- b. Greater optionality for use of spectrum in the future. No one knows what wireless technologies will become available in coming years. Having 3x3 MHz channels gives greater optionality to adopt future technologies than 12.5 kHz channels. These future technologies may be applied for industrial applications and to improve security for critical infrastructure and to deter cyber-security threats.
- c. Putting FCC-held spectrum to use – the EWA/pdvWireless proposal would put substantial FCC-held spectrum to use. The value of this increased utilization is substantial and is calculated below.
- d. Licensees in the 900 MHz band would have the right to continue to use their license as they currently do as well as the option to request a build-to-suit broadband service from a PEBB licensee. Because such options typically have economic value, the proposed availability of broadband services to narrowband licensees will increase the value of narrowband licenses.
- e. Rules in the 900 MHz band are decades old. There are reasonable expectations that the rules will be updated, but there is great uncertainty as to how those rules will be updated. Adopting a specific plan such as the EWA/pdvWireless proposal would clarify rules and remove uncertainty about the status of rules, factors which may be weighing down the value of 900 MHz licenses.

*Estimation of increased market value and consumer surplus of 900 MHz spectrum*

We can estimate the consumer surplus associated with putting underused 900 MHz spectrum to use. In particular, the substantial portion of the 900 MHz band, currently reserved by the FCC, would be put to use in each MTA. Spectrum is not depletable; use of spectrum today does not diminish its use tomorrow. Consequently, failure to use spectrum today is a permanent loss of the value of that spectrum today. We can approximate the value to both private sector users and to the American public of the unused, FCC-held portion of the 900 MHz band as follows:

- a. Based on the EWA/pdvWireless proposal, as much as 40 percent of the band (4 MHz out of 10 MHz) would be assigned to the new narrowband (2x2). Under the proposal, 6 MHz would be reallocated for wireless broadband.
- b. Wells Fargo recently valued 14 MHz of Sprint 800 MHz SMR spectrum at between \$0.50 and \$2.25 per MHz pop, with a central value of \$1.25 - \$1.50 per MHz pop.<sup>26</sup> Even placing the 900 MHz spectrum at the lower end towards \$0.50 - \$1.00 per MHz pop because it cannot be used for broadband purposes,<sup>27</sup> the market value of the underused 6 MHz of the 900 MHz band is between \$1 billion and \$2 billion. This increase in commercial value is a one-time event, whereas the consumer surplus associated with more value spectrum use occurs annually. I calculate these values as follows:

325 million pops x 6 MHz x \$0.5/MHz pop = approx. \$1 billion;

325 million pops x 6 MHz x \$1/MHz pop = approx. \$2 billion.

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<sup>26</sup> Wells Fargo, “Wireless Spectrum Primer, Second Edition,” June 21, 2017, Exhibit 10.

<sup>27</sup> We recognize that the value of CMRS spectrum may be different from spectrum for private networks, although it is not obvious which is greater. We will conservatively assume that CMRS spectrum has greater value.

- c. Adopting a method from Bazelon and McHenry, we can find the annual consumer surplus from this underutilized spectrum is also between \$1 billion and \$2 billion.<sup>28</sup> Bazelon and McHenry reviewed major economic studies of consumer surplus and spectrum market value associated with wireless services. They observed that the ratio of annual consumer surplus to spectrum market value in these studies ranges between 1.0 and 1.7. Using a conservative ratio of 1.0, one finds that annual consumer surplus for 900 MHz spectrum would be between \$1 billion and \$2 billion, corresponding to its market value. This is how much American consumers, not the licensees, would benefit each year from the licensed spectrum being put to effective use. This is also the amount of annual loss to users of the spectrum, ultimately including American consumers, by having this spectrum sit idle.
- d. Using a 10% discount rate, the net present value of the consumer surplus of the underutilized spectrum is between \$10 billion and \$20 billion.<sup>29</sup> Stated differently, private parties may value the underutilized spectrum at between \$1 billion and \$2 billion, but the American public, and ultimately the federal government, should value getting the spectrum in use at roughly \$10 billion and \$20 billion. This is a considerable sum, and every year of delay of putting the 900 MHz band to greater use costs the American public at least between \$1 billion and \$2 billion.

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<sup>28</sup> C. Bazelon and G. McHenry, "Mobile Broadband Spectrum: A Vital Resource for the U.S. Economy," May 2015, pp. 15-17 and Table 3, available at [http://www.ctia.org/docs/default-source/default-document-library/brattle\\_spectrum\\_051115.pdf](http://www.ctia.org/docs/default-source/default-document-library/brattle_spectrum_051115.pdf)

<sup>29</sup> I chose 10% as the discount rate, a common discount rate for large public investments. Some government agencies use lower discount rates. A 5% discount rate would double the net present value of the 10% discount rate calculations. See also Bazelon and McHenry, Table 3.

### 3. Externalities

The EWA/pdvWireless proposal would lead to substantial benefits both for the PEBB licensees and for the broader economy generally. Let's begin with the direct benefits to the PEBB licensee just from the direct use of unused, FCC-held spectrum.

#### 3. The additional value of externalities

In the preceding section, we reviewed the increased market value of 900 MHz licenses under the EWA/pdvWireless proposal. There are likely to be substantial increased values from the 900 MHz band not captured by licensees or their immediate customers through consumer surplus but by others in the economy. For example, in Puerto Rico, Google - based on 900 MHz spectrum from pdvWireless and others - was able to put together an emergency broadband network.<sup>30</sup> Neither the 900 MHz licensees nor their immediate industrial customers were the beneficiaries of this emergency use of the band. Rather, the consumers of Puerto Rico directly benefitted.

The recent Puerto Rico example is based on the availability of cleared and aggregated spectrum at 900 MHz. Other examples rely instead on the likely greater survivability of private networks in the 900 MHz band than public networks in other bands. Thus, in Texas during a recent hurricane, 900 MHz networks, because they were built to higher standards, remained operational when public networks failed.<sup>31</sup> In the future, in response to homeland security threats or cyber-security attacks, private networks in 900 MHz may be more likely to survive than public networks. Allowing these networks to have broadband capabilities may lead to survivable

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<sup>30</sup> [citation]

<sup>31</sup> [citation]

broadband networks to the greater benefit of all U.S. citizens, not just the 900 MHz licensees and their customers.

### **III. Conclusion**

We have seen nothing in the record to identify social costs associated with the EWA/pdvWireless proposal. There are many benefits of the EWA/pdvWireless plan that we divide into three areas: rule of law and property rights; increased value of spectrum; and externalities. Most of these benefits are not immediately quantifiable, but we have calculated increased market value and the increased consumer surplus just from putting additional 900 MHz spectrum into use. We calculate the market value of this increased use to be at least \$1 billion, and the net present value of increased consumer surplus to be at least \$10 billion. Consideration of the other benefits of the plan would increase the value substantially. Every year of delaying implementation of the EWA/pdvWireless plan costs American consumers at least \$1 billion.